

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1-63 (Cancel).

64. (New) An electro-magnetic device comprising:  
at least one input;  
a plurality of outputs;  
means for directing at least one electro-magnetic signal or photon from one of the at least one inputs to a selected one of the outputs, the selection being dependent upon at least an orbital angular momentum of the or each at least one electromagnetic signal or photon.

65. (New) A device as claimed in claim 64, wherein the selection is dependent upon:  
orbital angular momentum,  $l$  (OAM) solely;  
orbital angular momentum and spin angular momentum,  $s$  (SAM) individually; or  
orbital angular momentum and spin angular momentum combined, that is, total angular momentum,  $j$ .

66. (New) An electro-magnetic device as claimed in claim 64, wherein the means for directing comprises at least one interferometer.

67. (New) An electro-magnetic device as claimed in claim 66,  
wherein the or each interferometer includes means for  
inducing, in use, a rotation or inversion of an  
electromagnetic mode of an electro-magnetic signal such  
as light mode of a photon in at least one arm of the  
interferometer.
68. (New) An electro-magnetic device as claimed in claim 64,  
wherein the device includes means for rotation of a  
polarisation state and hence spin angular momentum of a  
photon or photons.
69. (New) An electro-magnetic device as claimed in claim 68,  
wherein the means for rotation allows an output of the  
device to be determined by total angular momentum of a  
photon or photons not solely by orbital angular momentum.
70. (New) An electromagnetic device according to claim 64 which  
is an optical device.
71. (New) An electromagnetic device according to claim 64  
wherein the means for directing said at least one  
electro-magnetic signal is a phased-array antenna adapted  
to detect angular momentum in or of said at least one  
electro-magnetic signal.
72. (New) An electro-magnetic device according to claim 71,  
wherein the device is adapted for use within a frequency  
range selected from one of: radio, a millimetre wave and  
microwave.

73. (New) An apparatus comprising a plurality of cascaded devices, each device comprising:
- at least one input;
  - a plurality of outputs;
  - means for directing at least one electro-magnetic signal or photon from one of the at least one inputs to a selected one of the outputs, the selection being dependent upon at least an orbital angular momentum of the or each at least one electromagnetic signal or photon,
- wherein the devices are arranged with an at least one output of one device communicating with another device.
74. (New) An apparatus as claimed in claim 73, wherein the apparatus comprises a signal processing apparatus.
75. (New) An apparatus as claimed in claim 73, wherein the cascaded devices are optical devices and a hologram is disposed between an output of the one optical device and an input of the another optical device, so that, in use, the hologram acts to increase the orbital angular momentum of the or each photon which passes through the hologram.
76. (New) A system including at least one device comprising:
- at least one input;
  - a plurality of outputs;

means for directing at least one electro-magnetic signal or photon from one of the at least one inputs to a selected one of the outputs, the selection being dependent upon at least an orbital angular momentum of the or each at least one electromagnetic signal or photon,

said at least one device providing the system with at least two possible output groups of output photons or states, the groups or states being selected by the device depending on an orbital angular momentum feature of an input photon.

77. (New) A system as claimed in claim 76, wherein the system is an optical communications system, such as a free space optical communication system.

78. (New) A method of communication or signal processing comprising the steps of:

providing a device comprising:

at least one input;

a plurality of outputs;

means for directing an electro-magnetic signal from the at least one input to a selected one of the outputs, the selection being dependent upon an orbital angular momentum of the electro-magnetic signal;

inputting the electro-magnetic signal into the device; detecting a feature of the orbital angular momentum of the electro-magnetic signal; and directing the electro-magnetic signal to a selected one of a plurality of outputs, the selected output for the electro-magnetic signal being selected by the detected property of the electro-magnetic signal.

79. (New) A method of communication or signal processing according to claim 78 further including multiplexing using angular momentum of electro-magnetic beams by generation and sensing using phase differences in arrays of antennae.